June 1968

SM-5.2

CIVIL DEFENSE, U.S.A.

A Programmed Orientation to Civil Defense

UNIT 2

NUCLEAR WEAPONS EFFECTS

DEPARTMENT OF DEFENSE

OFFICE OF CIVIL DEFENSE

STAFF COLLEGE

PANEL 1

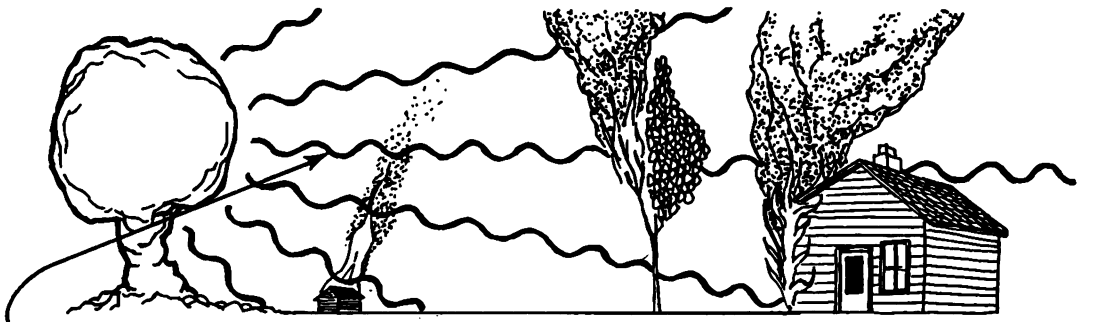
THE STORY OF TWO RAIDS

1. In the largest mass air raid on England in World War II, 437 aircraft attacked Coventry, England. They dropped 394 tons of high-explosive bombs, 56 tons of incendiary bombs, and 127 parachute bombs. The results? Three hundred and eighty persons were killed, 800 were injured, and extensive damage was done.

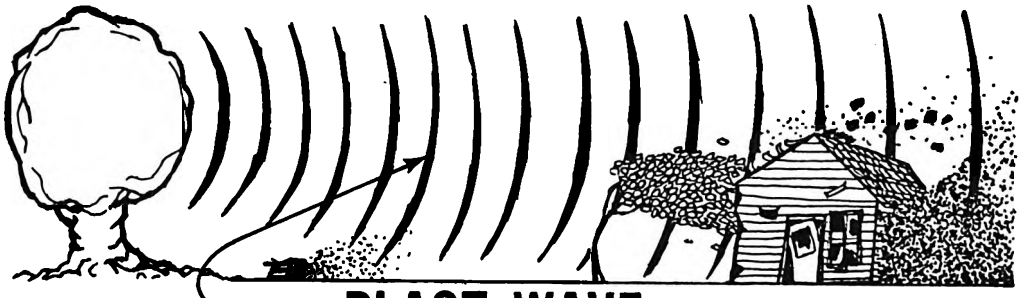
2. Three aircraft flew over Hiroshima; only one bomb was dropped, a 20-kiloton atomic bomb, equivalent in explosive power to 20 thousand tons of TNT. (This is a small bomb by today's standards.) The toll? About 70,000 persons killed, about 70,000 injured, 62,000 buildings obliterated, and 4.7 square miles of the city destroyed.

PANEL 2

MAJOR EFFECTS OF A NUCLEAR EXPLOSION

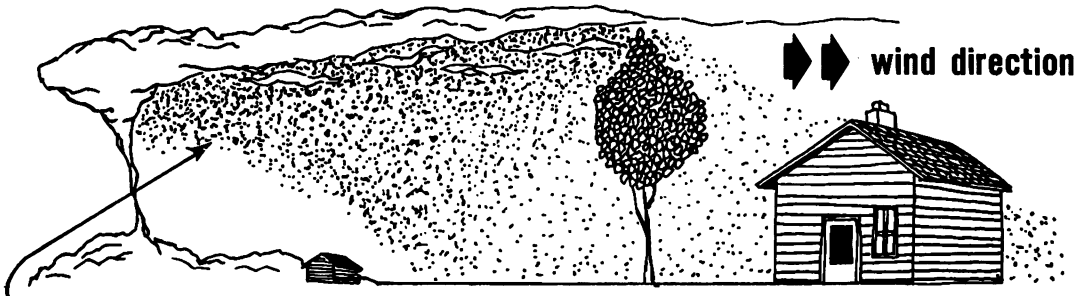


HEAT and INITIAL NUCLEAR RADIATION



BLAST WAVE

SHOCK WAVE

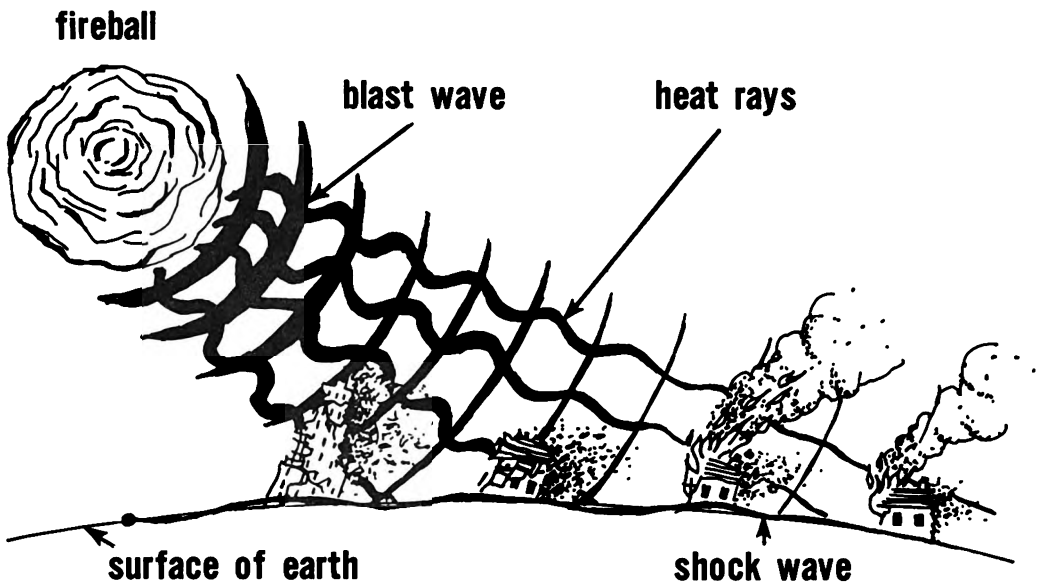


RADIOACTIVE FALLOUT

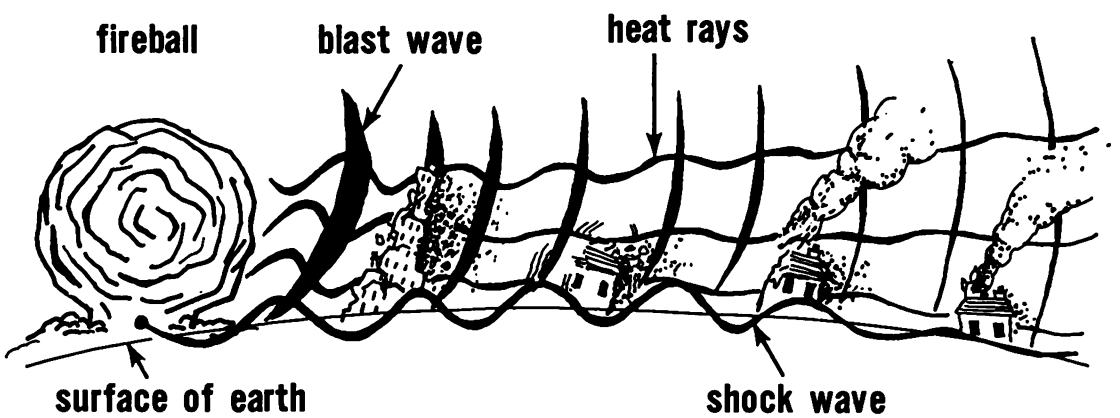
(results in residual nuclear radiation)

PANEL 3

THE TWO TYPES OF NUCLEAR EXPLOSIONS AND A COMPARISON OF THEIR EFFECTS



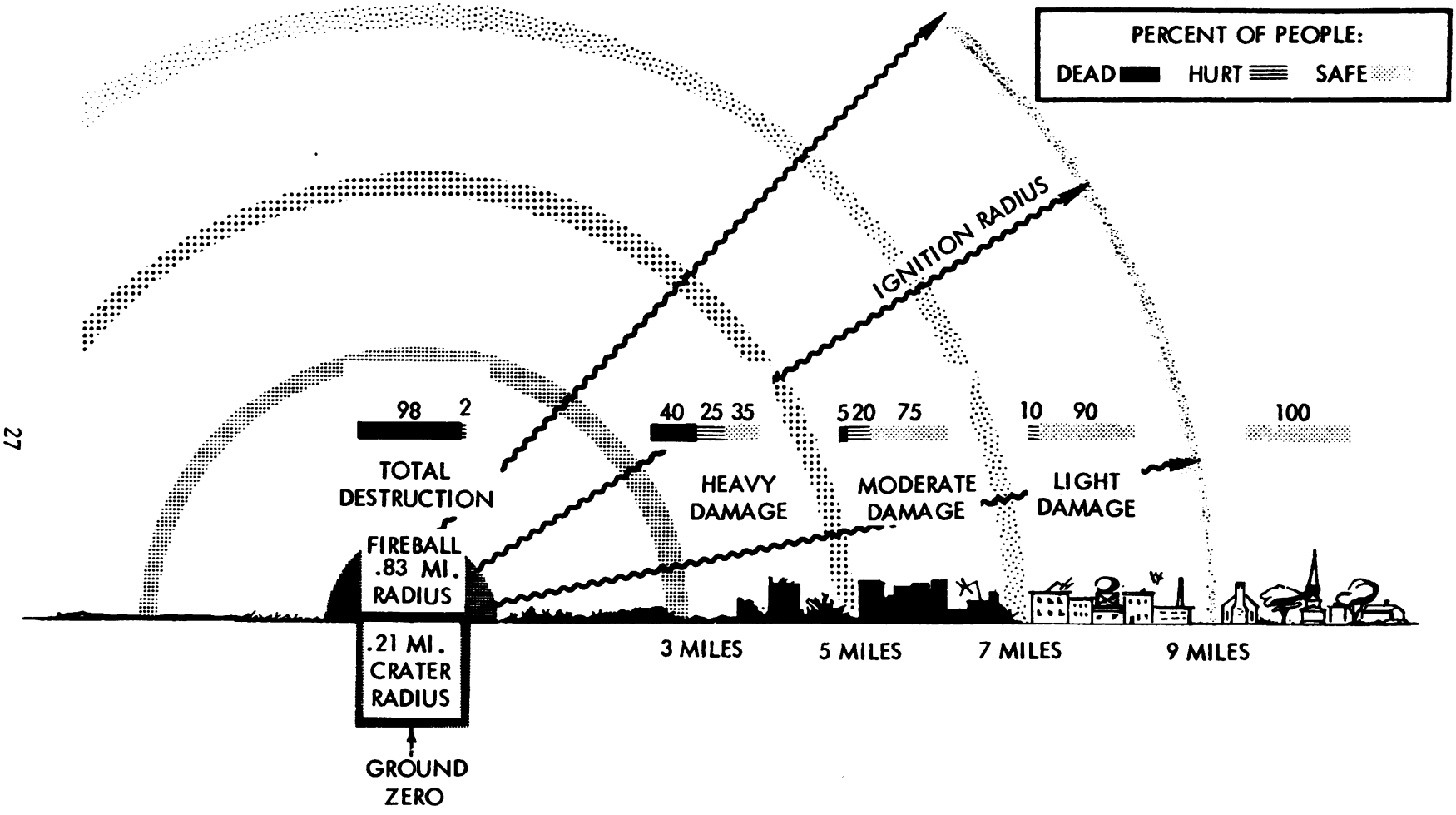
AIR BURST*



GROUND BURST

*The effects of an air burst depend upon the power and altitude of the burst. The most destructive height for a 20 KT weapon is about 2,000 feet; for a 1 MT weapon, it would be about 6,500 feet, etc.

EFFECTS* OF A 5 MT BLAST

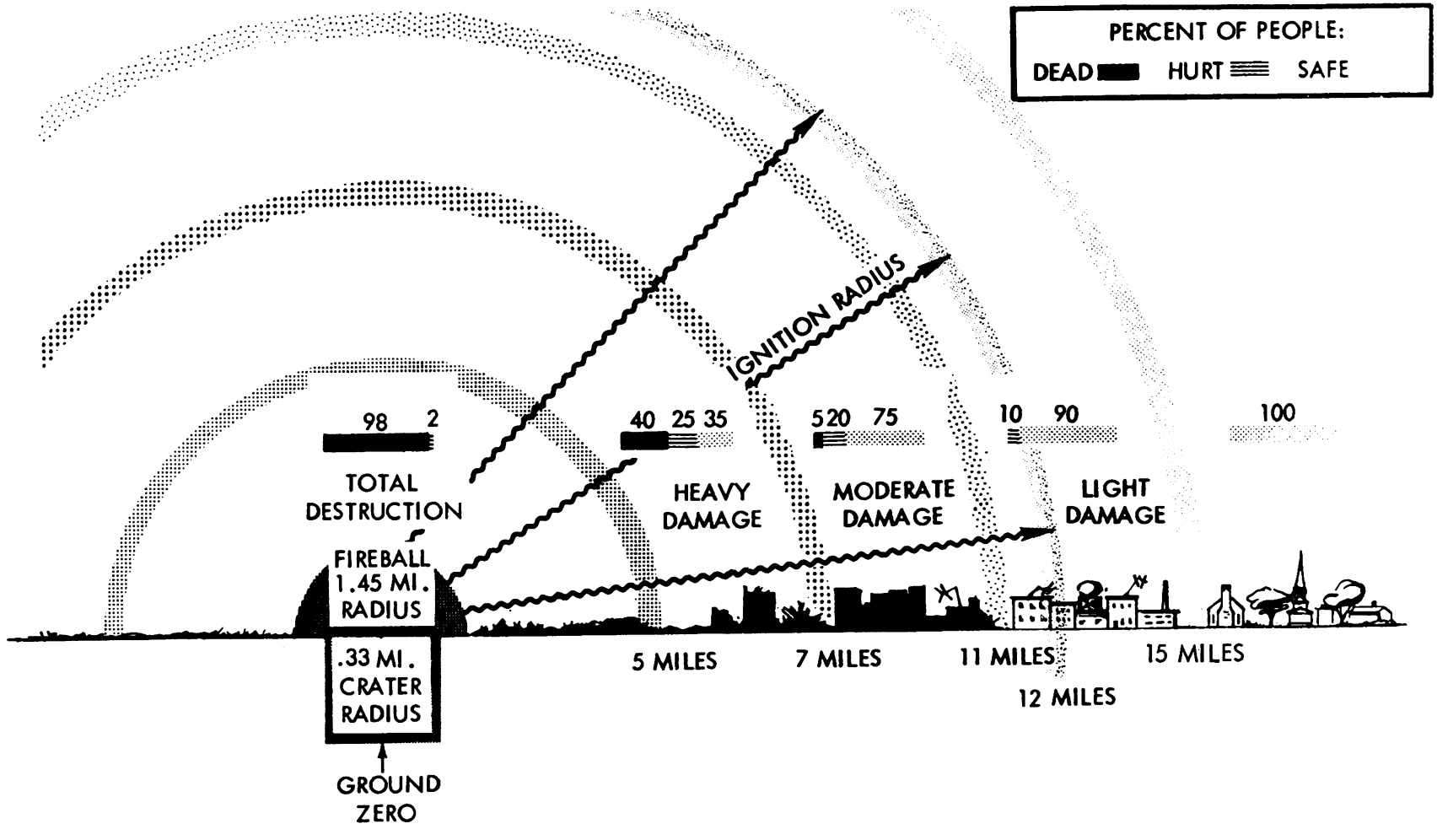


PANEL 4

If burst is elevated to altitude maximizing reach of blast damage:
"Moderate Damage" from blast is extended from 7 to 11 miles
"Ignition Radius" (ignites newspaper) is extended from 9 to 10 miles

*The results given are based only on blast and heat effects. The effects of shock and fallout are not taken into account.

EFFECTS* OF A 20 MT BLAST



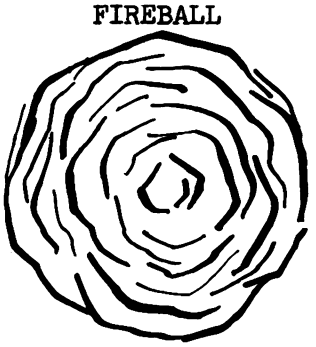
If burst is elevated to altitude maximizing reach of blast damage:
"Moderate Damage" from blast is extended from 11 to 17 miles
"Ignition Radius" (ignites newspaper) is extended from 12 to 17 miles

*The results given are based only on blast and heat effects. The effects of shock and fallout are not taken into account.

PANEL 5

PANEL 6

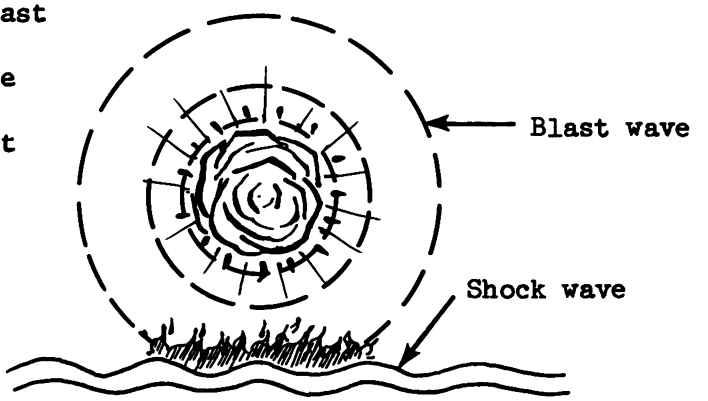
NUCLEAR EXPLOSION
(LOW AIR BURST)



HEAT AND INITIAL
NUCLEAR RADIATION

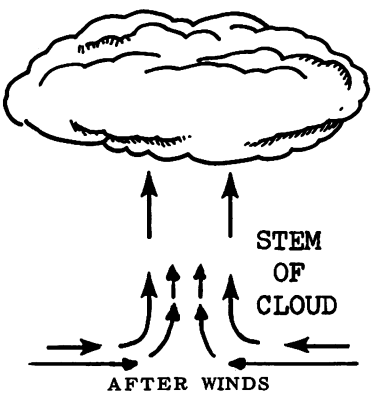
STAGE 1

The explosion is initiated by the union of pieces of nuclear material to produce the explosive critical mass. The nuclear reaction creates a fireball and produces a fantastic amount of heat which chars and ignites any combustibles within range, and initial nuclear radiation which can be fatal but which, because of its limited range, can be dropped from consideration (Stage 1). The fireball rapidly expands, pushing the air in front of it, creating a powerful blast wave that levels everything near the center of the explosion. This blast wave hits the ground and sets off a powerful ground shock that is much like an earthquake (Stage 2).



PROGRESS OF BLAST AND SHOCK WAVES

STAGE 2



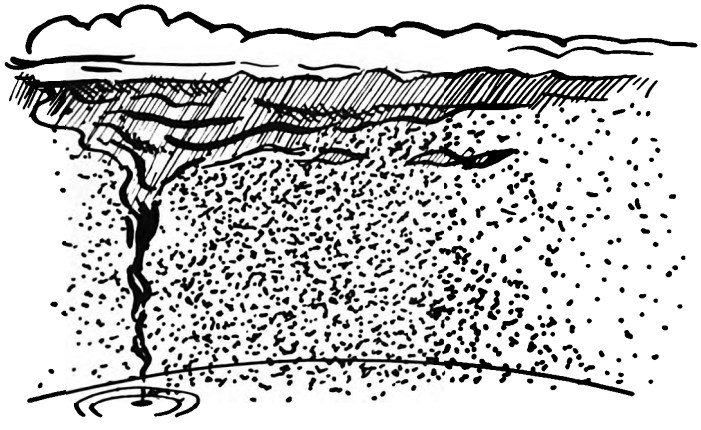
FORMATION OF STEM
OF MUSHROOM CLOUD

STAGE 3

Following the initial explosion, the fireball rises rapidly, producing strong "after winds" blowing inward and upward (Stage 3) which are similar to the updraft in a chimney. These winds, and the dirt and debris they pick up, form the stem of the mushroom cloud that is developed in Stage 4.

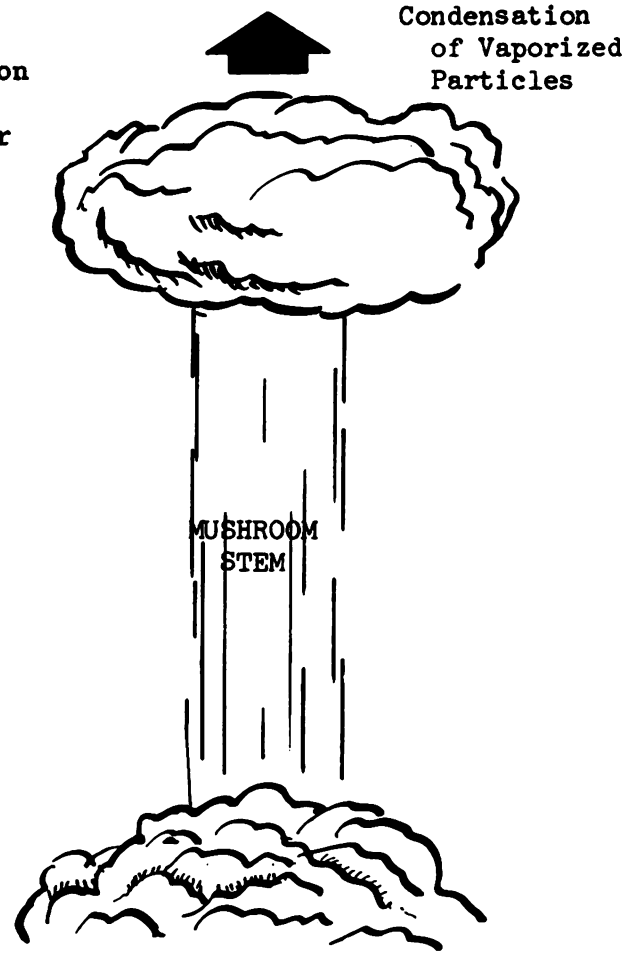
PANEL 6 (Continued)

As the fireball rises, there is condensation of the vaporized particles from the nuclear weapon on the dirt and debris, to form a cloud of small, solid, and highly radioactive particles (Stage 4). This cloud is dispersed by the winds at high altitudes. The particles then settle to earth as radioactive fallout (Stage 5).



FALLOUT

STAGE 5



FULL DEVELOPMENT
OF MUSHROOM CLOUD

STAGE 4

PANEL 7

RADIOACTIVITY - RADIATION - CONTAMINATION

Radioactivity

The essential difference between atoms of different elements lies in the number of protons in the nucleus. A hydrogen atom, for example, contains only 1 proton; a helium atom has 2 protons; and a uranium atom has 92 protons. Although all the nuclei of a given element contain the same number of protons, they may have different numbers of neutrons. The resulting atomic species, which have identical atomic numbers but which differ in their masses, are called "isotopes" of the particular element.

Radioactivity is the process whereby isotopes of certain elements spontaneously emit particles and/or rays from the nuclei of their atoms. Some elements are naturally radioactive, whereas others can be made artificially radioactive by bombarding the nuclei. Significant initial radiation from a nuclear explosion includes gamma radiation and neutrons. Significant later radiation (fallout) includes gamma rays and beta particles. Beta particles are high-speed electrons, and gamma rays are similar to X-rays although usually more penetrating than X-rays.

Natural radioactivity is characterized by the ability of certain types of atomic nuclei to decay spontaneously, giving off alpha, beta, or gamma radiations, or combinations of these.

In a nuclear explosion, various isotopes of many normally stable elements can be created. Although most are radioactive, they produce beta and gamma radiation; none produce alpha.

Exposure to Radiation

When large amounts of radiation are absorbed by the body in short periods of time, sickness and death may result. In general, the effects of radiation exposure stay with people and accumulate over a period of time. Few people get sick who have been exposed to 100 Roentgens or less. Exposure to more than 300 Roentgens over a period of a few days will cause sickness and may cause death. And death is expected to ensue for almost everyone who receives an exposure of 600 Roentgens over a period of a few days. The effects of similar exposures over a period of months or years are still under study, though in general, even a fairly large dose of radiation absorbed over months or years is not as dangerous as when absorbed over a few days. In the former case, the body is able to repair much of the cell damage as it occurs.

PANEL 7 (Continued)

Contamination

Contamination is the deposit of radioactive material on the surfaces of structures, area, objects, or people following a nuclear explosion.

Contamination could be caused by fallout material settling on persons outdoors while fallout was descending. It could also be caused by persons getting fallout material on themselves if they entered a very dusty area after fallout was down.

Decontamination is the reduction or removal of contaminating radioactive fallout from a structure, area, object, or person.